Exploring dark matter & the nature of neutrinos

Reina Maruyama
Professor

Reina Maruyama develops technologies and carries out experiments to probe the underlying physics of fundamental symmetries, origins of the Universe, and nature of neutrinos and dark matter. The Maruyama group uses techniques being developed in the fields of quantum sensors, atomic, nuclear, particle, and astro-physics to solve some of the greatest mysteries of the evolution of the Universe.

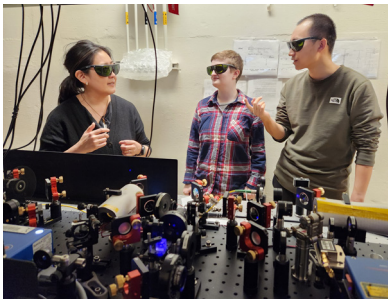
Maruyama is an American Physical Society (APS) Fellow. She was awarded the Sloan Research Fellowship, NSF CAREER Award, Yale Public Voices Fellowship, and the APS Committee on the Status of Women in Physics Woman Physicist of the Month (June 2013).

Maruyama was featured in Ingenium's Women in STEM initiative and is the co-leader of Yale's Asian Americans in STEM initiative.

Haloscope At Yale Sensitive To Axion Cold Dark Matter (HAYSTAC)

The Maruyama group develops and uses several experiments to search for axions, which are very low mass particles that are a theorized candidate for dark matter. HAYSTAC, which Maruyama co-leads with Steve Lamoreaux, is a tunable radiofrequency cavity resonator, which serves to build up the axion signal. HAYSTAC uses photon sensors often used for quantum computing, as well as an innovative quantum noise squeezing technique to speed up the data taking of the experiment. HAYSTAC is located at Wright Lab, and the Yale team is responsible for systems engineering, cryogenics, and magnetics.

Axion Longitudinal Plasma HAloscope (ALPHA)



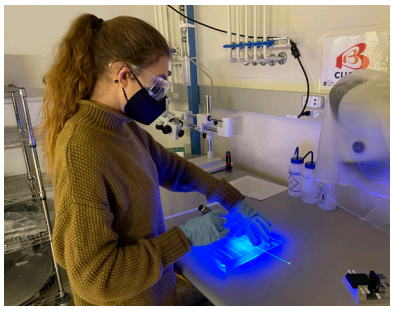
ALPHA will build on HAYSTAC's success and search for higher mass axions by employing a novel axion detector called a plasma haloscope. ALPHA will comprehensively investigate how new experimental ideas using plasmas can be used to detect the axion.

Rydberg Atoms at Yale (RAY)

To extend the mass range accessible by axion dark matter search experiments, the RAY group is is developing a single-photon detector for haloscope experiments, such as HAYSTAC and ALPHA. The detector is based on microwave transitions between highly excited Rydberg states in potassium atoms.

COSINE-100

COSINE-100 is a direct-detection dark matter experiment at the Yangyang Underground Laboratory in South Korea. The experiment is designed to test the DAMA/LIBRA Collaboration's claim that they have made a direct detection of dark matter, based on an annual modulation they observed in their data. COSINE-100 aims to understand the origin of DAMA's signal and search for their reported annual modulation signature by using the same target and detector material. Maruyama is the Principal Investigator of COSINE-100 and the scientific co-spokesperson of the experiment.



Cryogenic Underground Observatory for Rare Events (CUORE)

CUORE, and its successor CUPID, both located in Italy, are searching for a previously undetected process called neutrinoless double beta decay. If such a process is observed, it would demonstrate that neutrinos are their own antiparticles, offering a possible explanation for why we live in a Universe of matter, not antimatter.

Maruyama and Karsten Heeger are co-Principal Investigators of CUORE. The Wright Lab CUORE team has been responsible for the design, construction, and commissioning of the Detector Calibration System; analysis and simulation of data; and R&D.